SALMON TROUT STEELHEADER

AP April-May 1975 75¢

SPECIAL

FLY FISHING ISSUE

To Subscribe see Page 37

the dams without total hatchery compensation, then PGE would have to enlarge and provide additional O&M to the hatchery to produce the number of smolts of all species, needed for attaining the potentials. If this occurred, the company would no longer be responsible for providing any shutdown of the River Mill and Faraday power plants.

Oregon Wildlife Commission
William Saltzman - James Griggs
Fish Commission of Oregon
James Hass - - Lawrence Korn

Flow deflectors should help to re-establish healthy runs of steelhead and salmon once again to Idaho

Editor's Note: *This year, 1975, will be another year of reduced upriver runs of salmon and steelhead into the Snake River system. The drastic decline of the "B" run steelhead in 1974, a run reduced to an extinction level, will be repeated again this year and the summer chinook run bound for the Snake River may be lower than in 1974. This estimate is due to calculations by the National Marine Fishery Service. In 1972 slotted gates were placed at some dams as an emergency measure to decrease the nitrogen supersaturation in the Snake and Columbia Rivers. In that year 5 million smolts left the Snake River and only 500,000 reached The Dalles Dam check point. The Army Corps of Engineers put the slotted gates in without evaluating their effect upon the outmigrating smolts; the smolts were killed by nitrogen supersaturated water and its cure.*

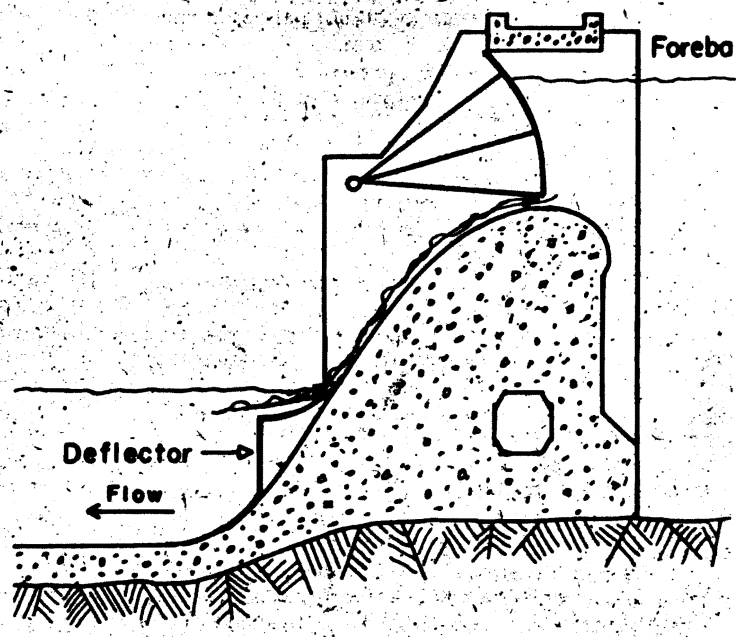
On October 9, 1974 the Oregon Wildlife Commission closed the Snake River and its tributaries to all angling until October of 1975 to protect what remained of the smallest run of summer steelhead ever recorded into the Snake River (see STS Dec.-Jan., pp 42). These steelhead were returning adults from the 1972 smolt outmigration. A poor run was predicted, yet a commercial fishery was put on these fish. This year there will be a commercial fishery on the Columbia for seven days in March. Soon after that the river will be closed to sport fishing. The closure, however, will not extend far enough into August to give adequate protection to the almost extinct "B" run summer steelhead bound for the Snake and Clearwater Rivers. Protection of these fish may require another emergency closure.

The following article is a description of the research done on the flow deflectors now used instead of the slotted gates to reduce nitrogen supersaturation on the Columbia.

SUPERSATURATION OF DISSOLVED NITROGEN gas associated with spilling of water at dams in the Columbia River Basin has been evident since the late 1960's. Severe losses of downstream migrating juvenile chinook salmon and steelhead trout, due to high concentration of dissolved gas in the water, have been recorded during high flow years since 1968. These losses reached a peak of 70% in 1970. Similarly, high nitrogen supersaturation causes losses among upstream-bound adult salmonids. Spring and summer chinook adults, for example, are migrating during the spring and early summer freshet period, a time coincident with high (135% and greater) nitrogen supersaturation.

Studies conducted by NMFS in cooperation with the U.S. Army Corps of Engineers revealed that dam spillways entrained large quantities of air into the water creating high nitrogen levels. The Corps is presently considering several methods of alleviating nitrogen supersaturation, but the most promising method developed to date is a concrete lip (known as a flow deflector or "Flip-Lip") that can be added to existing spillways. These deflectors can also be easily incorporated into plans for new dams. For example, recently constructed Lower Granite Dam on the Snake River incorporated spillway deflectors in its design.

Any nitrogen abatement device that is acceptable must not only reduce nitrogen input, but its use must permit safe passage of juvenile salmonids and must not interfere with passage of (or injure) upstream-migrating adults.



In 1973, personnel of the Coastal Zone and Estuarine Studies Division evaluated the use of flow deflectors at Lower Monumental Dam and the results were encouraging. Since spillbays were still under construction at Lower Granite Dam in 1973, information from the tests led directly to the installation of flow deflectors there. Further application of the flow deflector concept was adopted by the Corps for implementation at Bonneville Dam and by April 1 1974, four spillbays were modified with flow deflectors. (Bays number 13, 15, and 18).

It was thought that Bonneville Dam should be given high priority among mainstream Columbia River dams for installation of the flow deflectors if they proved practical because more adults pass over Bonneville than any other dam on the river and millions of fall chinook juveniles are released into the river just upstream from the dam. Also, the low turbine capacity at Bonneville Dam required more frequent spilling than is the case with similar flows at upstream dams. Bonneville Dam was, therefore, selected for further testing of the deflectors.

Flow Deflectors Reduce Dissolved Nitrogen Gas Levels

Water was sampled below bays 13, 14, and 15 equipped with flow deflectors (test) and below standard bays 2-6 with no deflectors (control). Model observations at the Bonneville Hydraulics Laboratory were made to determine spill volumes and tailwater elevations suitable for tests. Flows were selected to cover those occurring typically during periods of juvenile fish migration. Spill volumes

tested were 6,700, 9,700, 13,800, 17,000, and 20,000 cfs per bay at tailwater elevations of 17 to 28 feet.

Observations of the spillway model indicated some mixing of water flowing through control and test bays during the tests; however, no mixing could be detected by our sampling so contamination was considered to be minimal. If mixing did occur, it would have tended to increase absolute gas content of the deflector bay samples and would not affect the standard bay samples.

During the test, spillbay flows of 6,700 cfs increased the nitrogen level from 100% saturation in the forebay to 129% below the control bays and to about 117% below the deflector bays. At higher flows of 13,800 cfs, supersaturation increased to 130% below the standard bay, but increased only to 123% below the deflector bay. At all flows tested, the Nitrogen supersaturation increase was less below the deflector bays than below the standard spillbay.

Based on these tests we can say that if a full complement of deflectors are placed in all 18 spillbays at Bonneville and these gas levels from our studies are representative (with river flows of 300,000 - 360,000 cfs and a forebay saturation of 110% or less), the mixed river condition downstream will be 3.8 - 5.5% less than would normally have occurred with standard spillbays. However, it is difficult to extrapolate these 3-bay tests to a completely modified spillway condition at Bonneville with certainty. For example, when we tested nearly a full complement of flow deflectors at Lower Monumental Dam (five of eight bays with deflectors), a greater nitrogen reduction was noted than had been anticipated. From test information so far, there is no reason to believe that multiple bay discharges will not substantially lower the overall concentrations of dissolved gases below Bonneville Dam.

Flow Deflectors Not Detrimental to Downstream Passage of Juvenile Fish

Juvenile fall chinook salmon were used to examine effect of deflectors on passage and survival because this species had not been tested previously and because they are the most abundant seaward migrants occurring at Bonneville. Tests run in previous years with young coho salmon and steelhead trout at Lower Monumental Dam showed survival was enhanced in passage over deflectors as compared with standard bays.

At Bonneville Dam three groups of about 150,000 chinook were marked distinctively by branding 1 month prior to release. Simultaneous releases were made through 4-inch hoses placed about 1 foot from the spillgate opening in Bay 11 (standard bay) and Bay 14 (modified with flow deflector). A control release was made about 1 mile from the dam to the Washington shore.

Test fish were released on July 10, the time of year when maximum numbers of juvenile fall chinook are migrating. An effort was made to simulate average river flow conditions during natural migration periods. Spillgates 10-15 were set so that approximately 13,000 cfs passed through the spill openings of each gate 1 hour prior to and following the releases. To measure survival differences, fingerlings from the test and control releases were recovered about 160 kilometers downstream by a beach seining operation.

Recoveries were made beginning July 13 and ending August 2. During the recovery period, many unmarked fall chinook were captured, substantiating the belief that this test coincided with the primary downstream movement of fall chinook.

Chi-square tests indicated no significant difference between test groups (i.e., groups released into standard or flow deflector bays) or between either test group and the control group released below the dam. These results indicate that spillway deflectors are not detrimental to the survival of juvenile fall chinook. The complete modification of the spillway, installing deflectors in all 18 bays, should not adversely affect juveniles passing over them.

Deflectors Harmless to Adult Passage

Radio tracking studies were done to determine the principal routes of adults below the dam in the vicinity of spillbay tailwater, and whether bodily injury would occur from counter currents and shearplane forces that might develop in the tailrace below the bays equipped with deflectors. Adult chinook salmon and steelhead trout were tagged with radio tags and tracked as they approached and passed over the dam so that each fish could be identified and tracked or followed. Initially, nine fish, each bearing a tag of different radio frequency, were released about 4 miles below the dam. Adults were tracked by fixed and mobile radio receivers. Passage over the dam was considered complete when the fish passed Cascade Locks about 4 miles upstream.

Between April 1 and June 27, 1974, 63 spring and summer-run chinook salmon and steelhead trout were tracked until they successfully passed over the dam. A wide range of flows of 250,000 cfs to 600,000 cfs occurred during the tracking but no injury or delay of adults could be attributed to water flow patterns created by the flow deflectors.

Future Plans for Flow Deflectors

Results obtained from experiments indicate that the reduction of nitrogen input by use of flow deflectors should far outweigh any detrimental effects in regard to adult passage at Bonneville. Consequently, the Corps of Engineers is now planning, with the endorsement of fishery agencies of the Pacific Northwest, to complete the modification of spillbays at Bonneville and Lower Monumental Dams in 1975. Other dams will also have deflectors installed.

When spillways are modified, the National Marine Fisheries Service will monitor the concentration of gases below each dam as completed. As progress is made with modification at each dam, nitrogen abatement can be assessed and related to the ultimate survival of valuable stocks of anadromous fish in the Columbia and Snake Rivers.

Don Parks
National Marine Fishery Service

Steelhead for Idaho

Editor's Note: *Mr. Stonebraker's letter will help illustrate the problems sportsmen and fishery biologists face on the Snake River: delay in smolt outmigration in slack water dam pools, nitrogen supersaturation, Operation Fish Run — the trucking of smolts from Little Goose Dam to below Bonneville Dam. Operation Fish Run will be described in the next issue of STS.*

ONE OF THE WORLD'S FINEST SPORTS FISH, the Atlantic salmon, was once so plentiful on the east coast of the United States that the textile workers in Hartford, Conn. went on strike complaining that they were tired of being fed salmon. Practically every stream from Maine down to the Carolinas was bulging with these great fish. Dams and pollution have cut the numbers of salmon on the East coast to the point where only a few streams in Maine have but reminant populations. The reestablishment of the Atlantic salmon has been, to date, largely unsuccessful. What has happened to the Atlantic